

## 12<sup>th</sup> International CAN Conference – Barcelona 2008

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### Introduction

In March 2008, the 12<sup>th</sup> International CAN Conference was held in Barcelona, Spain. This conference is run by non-profit organisation CAN in Automation (CiA) who are responsible for creating and maintaining CAN standards, as well as ensuring the continuous development of CAN. The purpose of the International CAN Conference is to provide a forum for all CAN users to discuss new developments in products using CAN, future progression of the protocols and usage, and tools and software available for testing and producing CAN systems and devices.

Many topics were discussed at the 12<sup>th</sup> International CAN Conference, from motion control applications to building automation and fault tolerant topology design. The three major CAN protocols discussed at the conference were CANopen, SAE J1939, and DeviceNet.

### Three Major Protocols

#### CANopen

CANopen was by far the most commonly discussed protocol at the conference, partially due to the continuously increasing number of applications in which is used. CANopen is a higher-level protocol whose standards allow for great flexibility in product design. Since the protocol does not have a rigid structure that describes all messages and devices that may be used, each device must be accompanied by an electronic datasheet (\*.eds file). However, as complexity increases, and simulation and testing procedures improve, another file type (\*.xml) has begun to be implemented to replace the ageing datasheet files. These new device description files remove the limitations faced with the older style electronic datasheets allowing simulation programs to fully represent any device in software by loading in these XML files. These files also contain all the information present in the EDS files, allowing for backwards compatibility.

By using these EDS and XML files, CANopen devices can be purchased 'off-the-shelf' and connected into almost any CANopen network with little configuration needed. Since all CANopen devices must comply to the CiA standards, 'off-the-shelf' products such as configuration tools and simulators can be purchased to configure, simulate, calibrate and monitor any CANopen compliant device. Due to its flexibility, CANopen is being used in an increasing number of applications, such as motor control, automation, instrumentation, and increasingly in vehicle applications. While SAE J1939 remains the standard of choice for heavy vehicle manufacturers, CANopen networks are becoming more common in smaller passenger vehicles, and J1939 to CANopen gateways are beginning to find their way onto trailers, thus allowing CANopen devices to be used on trailers of vehicles that ordinarily only utilise J1939. CANopen uses a master-slave configuration.

#### SAE J1939

J1939 is a very rigid CAN standard, which not only defines higher-level protocols, but also defines standards for almost every layer of the OSI architectural stack, all the way down to the physical layer including wire and connector types. While this rigid standardisation limits flexibility in system design, it improves the reliability and predictability of the system. Almost all messages to be transmitted on a J1939 network are defined in the standard, so

software tools and diagnostics tools can be purchased 'off-the-shelf' to simulate systems and devices, as well as monitor and diagnose problems. This rigid message structure and definition also means that messages to be present on a system are highly predictable, and message types fully predictable, which means new J1939 devices can be added to a J1939 bus with zero configuration necessary. However, there have been allowances made in the standard for undefined, or proprietary, products to connect to a J1939 bus, so long as those devices conform to the standard. J1939 uses a multi-master configuration, where all nodes communicate on the same level.

### **DeviceNet**

DeviceNet is another CAN-based protocol, that uses CAN as its backbone but defines its own protocol for the application layer, and defines the physical and data-link layers also. DeviceNet is most common in North America, but is rarely found in Europe, Asia, or Australia. The protocol was initially created by Allen-Bradley which is now owned by Rockwell Automation; however it has been released as an 'open' protocol, maintained by an independent body called the 'Open DeviceNet Vendors Association' who maintain the standards and tests for conformity. DeviceNet uses a master-slave configuration.

### **Tools and Software**

Many companies produce tools and software for all three mentioned CAN-based protocols. The companies that presented their products at the CAN conference this year were Vector Informatik GmbH and Port GmbH. Redarc attended workshops run by both companies, demonstrating how to use their software to create tests and simulations of systems without requiring a physical system initially. As the tests are conducted, simulation nodes can be replaced by physical nodes systematically so that every part of a system can be tested during its development. This process can rapidly reduce development times of both systems and individual devices. Both workshops used CANopen as their chosen protocol for the demonstrations, however CANopen can be replaced by J1939 or DeviceNet by the use of a different software plug-in. It was also show how this software can be used to verify the tests generated, to ensure there are no problems in the testing procedure.

### **Conference Summary**

Jason Turner is an Electronics Engineer, who has been working in REDARC's innovation centre for the past three years after completing a degree in Computer Systems Engineering, graduating with honours in 2005. He has recently returned from Barcelona where he attended the 12<sup>th</sup> International CAN Conference. Attending this conference were representatives from various industries including automotive, medical, railroad, industrial automation, building elevators, defence and academia. This representation provides some insight into the increasing acceptance of CAN for any form of control or communication in harsh environments.

The conference was split into two sections, a workshop section and a conference section. The workshop section had five different workshops, run in two streams. The workshops attended by REDARC were "Hands-on training of CANopen Test Generation" and "Rapid Prototyping for CANopen Applications".

The conference section was further divided into eight sessions, each dealing with a different aspect of CAN. These sessions were entitled:

- Session 1.** Motion Control Applications
- Session 2.** Topology and Architecture
- Session 3.** Building Automation
- Session 4.** System Design
- Session 5.** Fault Tolerance
- Session 6.** Software Design
- Session 7.** Physical Layer
- Session 8.** Vehicle Applications

## **Workshops and Sessions Commentary**

### **Workshop 1: Hands-on Training of CANopen Test Generation**

This workshop detailed how to set up a CANopen simulation to test devices as they are added to the CAN bus using tools produced by Vector Informatik GmbH. The theory operates as follows. Initially a test procedure is generated using a series of simulation nodes equivalent to what would be applied to a real circuit. Once the simulation circuit sufficiently passes all the tests, one of the simulation nodes is replaced with a real node and the tests repeated. This process is continued until all simulation nodes have been replaced with actual nodes and the circuit is operating as desired. This software can also be used to test the test procedure to ensure that any errors that arise during the testing are due solely to the device being tested and not caused by mistakes in the testing procedure. While this workshop focussed on devices using the CANopen protocol, the same software and testing methods can be applied to other protocols – such as SAE J1939 – with the addition of a plugin.

### **Workshop 2: Rapid Prototyping for CANopen Applications**

This workshop demonstrated the tools available from Port GmbH. The theory was similar to that used in the previous workshop, allowing for CANopen applications to be prototyped rapidly through software simulation tools.

#### **Session 1: Motion Control Applications**

The first session dealt with applications that used CAN to control motors for different purposes. These were 'real world' applications that demonstrated the benefits of CAN over other similar networks, which made them ideal for these applications. All presentations demonstrated the use of the higher-level CANopen protocol. While the specific applications were relevant only for interest sake, the problems and pitfalls encountered and resolved during the development were relevant to the development of all products using the CANopen protocol.

#### **Session 2: Topology and Architecture**

The second session was mainly intended for system designers, presenting alternative topologies and architectures that could be used in different circumstances that would provide the system with the most suitable and robust options for those particular circumstances. This session was only for interest for those of us who are not involved in system design; however it did highlight what problems can arise in topology and architecture and hence what issues we need to be aware of in design of our products.

#### **Session 3: Building Automation**

Session three was another session that looked at specific applications that used CAN as their chosen communications protocol. In particular, these applications were involved with

automating different aspects of buildings, such as door and window automation for homes of people with disabilities, and automating interlock systems in an electron synchrotron. Once again, while the applications were quite specific, the knowledge obtained through the development of these products can be applied in many other applications. For example, one application used mapping of certain CANopen messages to the Java Native Interface, so that programs written to operate on the Java platform could communicate with the CANopen products. Another example showed how a CAN I/O expander could be utilised for simple systems rather than a full CAN controller system, which allowed for much lower cost at the expense of flexibility.

#### **Session 4: System Design**

This session once again involved the use of CANopen devices and showed possible directions in which CANopen development may proceed to allow for the option of 'hot-swapping' "Fastscan" compatible CANopen devices. This session also investigated fast restarting of disconnected DeviceNet slave devices. Much of this session was theoretical and was mostly of use to those designing future systems.

#### **Session 5: Fault Tolerance**

All of the presentations in this session discussed ways in which to introduce redundancy into CAN systems to make them more reliable. While CAN is very robust, a critical failure on the bus (for example: the two CAN lines being shorted together by a faulty transceiver) will take the whole system down with it. Certain measures have been implemented in the CAN standards to avoid this (for example: babbling idiot shutdown), which is one of the reasons CAN is considered so robust, but in some cases it is unavoidable. The only real solution to this problem is through redundancy, and three different approaches were shown in this session. Again this session was mostly for interest for everyone other than component manufacturers, although it highlighted the importance of fault tolerance, ways in which errors can occur, and thus provoked consideration of design techniques to minimise the possibility of introducing errors when designing products.

#### **Session 6: Software Design**

Session six was devoted to the software design of products and systems, once again mostly focussed on CANopen device development. This involved many guidelines and suggestions to follow in development of CANopen devices, with an interesting presentation on the do's and don'ts of CANopen development. Future directions in CANopen software protocols were discussed, and methods for using the current protocol most effectively were demonstrated. It also introduced various tools and methods for testing software in development. This session was very beneficial to all those new to CANopen and those starting work on new CANopen devices.

#### **Session 7: Physical Layer**

The physical layer of CAN was discussed in session seven and was purely for interest for anyone other than component (in particular transceiver) manufacturers. Much of this session was theoretical, investigating different approaches to reducing the cost of developing and testing CAN components, as well as physical media such as the wires and termination used to carry CAN signals.

#### **Session 8: Vehicle Applications**

The last session of the conference was on vehicle applications for CAN. These applications ranged from networking the components of motor-assisted pedal-powered bicycles to sensor communication for maintaining the 'cold-chain' in refrigerated transports. This

session also mostly involved the use of the CANopen protocol, however it also looked at other CAN protocols such as SAE J1939, which is used in almost all trucks, from light to heavy-duty.

Over the past three years, representatives of REDARC have attended all of the annual International CAN Conferences run by the CAN in Automation group (CiA) held in Rome, Stockholm and Barcelona. These conferences connect professionals from all industries using CAN for a variety of different functions and applications, and present the latest innovations and improvements in the standards and associated protocols. While CANopen remains the most rapidly evolving CAN protocol, other CAN protocols such as SAE J1939 and DeviceNet are also undergoing continuous development and it is important for those using these protocols in industry to continue to learn about the changes and improvements, ensuring their knowledge remains complete and up to date. REDARC is the only Australian company to attend this years' conference, and the only Australian company to attend all of the previous three conferences.

For further information or assistance with CAN please contact Jason Turner or Lino Cardone at Redarc on +61 8 8322 4848 or email [power@redarc.com.au](mailto:power@redarc.com.au) and we will promptly respond to your enquiry.